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PRINT DATE: 01/12/94

**FAILURE MODES EFFECTS ANALYSIS (FMEA) - CRITICAL HARDWARE  
NUMBER: 06-1B-0760-X**

**SUBSYSTEM NAME: ARS - COOLING**

**REVISION: 9 01/12/94**

	<b>PART NAME VENDOR NAME</b>	<b>PART NUMBER VENDOR NUMBER</b>
LRU	: REGENERABLE CO2 REMOVAL SYSTEM	MC623-0016
SRU	: VALVE, SOLENOID	SV806914

**PART DATA**

**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:  
PRESSURE EQUALIZATION VALVE**

**QUANTITY OF LIKE ITEMS: 6**

**FUNCTION:**

- 1) VALVE 1 OPENS TO EXPOSE BED A TO VACUUM. THIS EQUALIZES THE PRESSURE ACROSS BOTH OUTLET VACUUM PORTS, ENABLING THE VACUUM CYCLE VALVE ACTUATOR TO OPEN THESE PORTS. VALVE 4 PERFORMS SAME FUNCTION FOR BED B VACUUM PORTS PRESSURE EQUALIZATION.
- 2) VALVE 2 OPENS TO EXPOSE BED A TO THE ULLAGE SAVE COMPRESSOR INLET, THUS AIR IS RECOVERED TO CABIN AND THE BED PRESSURE IS BROUGHT DOWN FROM AMBIENT TO 3.0 PSIA. VALVE 5 PERFORMS SAME FUNCTION FOR BED B ULLAGE SAVE. VALVES 2 AND 5 BOTH OPEN TO PERFORM BED EQUALIZATION. A FINAL NOMINAL PRESSURE OF 1.5 PSIA IN EACH BED RESULTS.
- 3) VALVE 3 OPENS TO REPRESSURIZE BED A TO CABIN PRESSURE. THIS EQUALIZES THE PRESSURE ACROSS BOTH THE INLET AND OUTLET PROCESS AIR PORTS OF THE VACUUM CYCLE VALVES, ENABLING THE VACUUM CYCLE VALVE ACTUATOR TO OPEN THESE PORTS. VALVE 6 PERFORMS THE SAME FUNCTION FOR BED B PRESSURE EQUALIZATION.

**FAILURE MODES EFFECTS ANALYSIS (FMEA) - CRITICAL FAILURE MODE  
NUMBER: 06-1B-0780-03**

**SUBSYSTEM: ARS - COOLING  
LRU: REGENERABLE CO2 REMOVAL SYSTEM  
ITEM NAME: VALVE,SOLEID**

**REVISION# 9 01/12/94 R**

**CRITICALITY OF THIS  
FAILURE MODE: 1R2**

**FAILURE MODE:  
EXTERNAL LEAKAGE**

**MISSION PHASE:  
OO ON-ORBIT**

**VEHICLE/PAYLOAD/KIT EFFECTIVITY: 102 COLUMBIA  
105 ENDEAVOUR**

**CAUSE:  
MECHANICAL SHOCK, VIBRATION, CORROSION, MATERIAL DEFECT.**

**CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO**

**REDUNDANCY SCREEN A) PASS  
B) PASS  
C) PASS**

**PASS/FAIL RATIONALE:  
A)  
B)  
C)**

**MASTER MEAS. LIST NUMBERS: V61P2901A  
V61P2902A  
V61P2911A  
V61P2912A  
V61P2922A**

**- FAILURE EFFECTS -**

**(A) SUBSYSTEM:**

1. A) EXTERNAL LEAKAGE DOWNSTREAM OF POPPET OF PEV VALVE 1 OR 4 WILL CAUSE DIRECT CONNECTION OF CABIN AIR TO VACUUM. THE LEAK WILL BE DETECTED BY CABIN DP/DT OR BY THE RCRS CONTROLLER IF THE LEAK RATE EXCEEDS 1.3 LB/HR. THE SYSTEM WILL SHUT DOWN. HOWEVER, THE LEAK WILL NOT BE ISOLATED.

B) EXTERNAL LEAKAGE UPSTREAM OF POPPET OF PEV VALVE 1 OR 4 WILL CAUSE A CABIN AIR LEAK TO VACUUM DURING THE DESORPTION CYCLE OF BED "A" OR "B", RESPECTIVELY. THE RCRS CONTROLLER WILL DETECT A LEAK RATE THAT EXCEEDS 1.3 LB/HR AND SHUT DOWN THE SYSTEM. BOTH BEDS WILL BE ISOLATED.

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2. VALVE 2 OR 5 FAILURE WILL CAUSE CABIN AIR LEAK TO VACUUM DURING DESORPTION CYCLE OF BED "A" OR "B", RESPECTIVELY. THE RCRS CONTROLLER WILL DETECT A LEAK RATE THAT EXCEEDS 1.3 LB/HR AND SHUT DOWN THE SYSTEM. BOTH BEDS WILL BE ISOLATED.

3. VALVE 3 OR 6 FAILURE WILL CAUSE CABIN AIR LEAK TO VACUUM DURING DESORPTION CYCLE OF BED "A" OR "B", RESPECTIVELY. THE RCRS CONTROLLER WILL DETECT A LEAK RATE THAT EXCEEDS 1.3 LB/HR AND SHUT DOWN THE SYSTEM. BOTH BED WILL BE ISOLATED.

**(B) INTERFACING SUBSYSTEM(S):**

INCREASED CABIN PPCO2. EXCESSIVE LOSS OF CONSUMABLES.

**(C) MISSION:**

POTENTIAL EARLY MISSION TERMINATION. N2 CONSUMPTION WILL RISE ABOVE NORMAL USAGE, MISSION DURATION DEPENDS ON CONSUMABLES AVAILABILITY.

**(D) CREW, VEHICLE, AND ELEMENT(S):**

NO EFFECT.

**(E) FUNCTIONAL CRITICALITY EFFECTS:**

1) GROSS EXTERNAL LEAKAGE OF VALVE 1 OR 4, ASSOCIATED WITH VACUUM VENT ISOLATION VALVE FAILED OPEN COULD RESULT IN EXCESSIVE CABIN AIR LEAK OVERBOARD (CRITICALITY 1R2 PNP).

2 & 3) LEAKAGE THROUGH RCRS REQUIRES RCRS SHUTDOWN TO ISOLATE BEDS AND STOP LEAK. LOSS OF USE OF THE RCRS, BACKUP LIOH CANISTER MUST BE USED FOR CO2 REMOVAL UNTIL LANDING. THE LIOH SUPPLY IS ADEQUATE TO ACCOMMODATE 3 DAY MISSION. VACUUM VENT ISOLATION VALVE CAN BE CLOSED IF LEAK CONTINUES. LOSS OF ALL BACKUPS MAY RESULT IN LOSS OF CREW/VEHICLE. A 1R3 PPP CRITICALITY SCENARIO RESULTS.

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**-DISPOSITION RATIONALE-**

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**(A) DESIGN:**

PEV VALVE IS A DUAL COIL SOLENOID-OPERATED, POPPET FLOW VALVE, MAGNETICALLY LATCHED OPEN AND SPRING LOADED CLOSED. THE VALVE BODY IS 430 STAINLESS STEEL, VESPEL SP-21 POPPET SEAT ARRANGEMENT WITH A FLUORO-SILICONE SEAT. O-RINGS (FLORO-SILICONE) SEAL VALVE BODY TO PEV MODULE.

**(B) TEST:**

QUALIFICATION TEST FOR 100 MISSIONS:

QUALIFICATION TEST IS PERFORMED WHEN THE PEV IS INSTALLED AT THE RCRS PACKAGE LEVEL. RANDOM VIBRATION INCREASING AT PLUS 6 db/oct FROM 20 TO 45 HZ; CONSTANT AT 0.003 g2/HZ FROM 45 TO 1000 HZ; DECREASING AT MINUS 6 db/oct FROM 1000 TO 2000 HZ FOR 48 MINUTES PER AXIS IN THREE ORTHOGONAL AXES.

**ACCEPTANCE TEST:**

PROOF PRESSURE- APPLIED INTERNAL PRESSURE OF 27 PSID, WITHOUT PERMANENT DEFORMATION OR DEGRADING OF PERFORMANCE.

LEAKAGE TEST- INTERNAL LEAKAGE ACROSS THE POPPET AND SEAT WITH THE PEV CLOSED IS NOT TO EXCEED .25 SCCM OF AIR AT 70 DEGREES F. WITH 14.7 PSID APPLIED; EXTERNAL LEAKAGE- NO AIR LEAKAGE WHEN 22.5 PSID IS APPLIED TO THE

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INTERNAL PRESSURE. BURST PRESSURE OF 38 PSID APPLIED TO THE INTERNAL PRESSURE WITHOUT RUPTURE.  
THE VALVE IS SUBJECT TO PULL-IN/DROP-OUT TEST FOR BOTH THE OPENING AND CLOSING COILS (PRIMARY AND REDUNDANT).  
INSULATION RESISTANCE TEST IS CHECKED FOR BOTH COIL-TO-CASE AND COIL-TO-COIL. THE VALVE IS TESTED FOR DIELECTRIC STRENGTH AND SHALL WITHSTAND 1250 VOLTS RMS INPUT VOLTAGE FOR THE COIL-TO-CASE TEST.

OMRSD:  
ANY TURNAROUND CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD AT SYSTEM LEVEL.

**(C) INSPECTION:**

RECEIVING INSPECTION  
INCOMING PART/MATERIAL IDENTIFICATION AND CERTIFICATION VERIFIED BY INSPECTION. KITTING, SOLDER AND ATP VERIFIED AT VENDOR BY H. S. SOURCE INSPECTION. DIMENSIONAL CHECKS PERFORMED AT VENDOR BY H. S. SOURCE INSPECTION.

CONTAMINATION CONTROL  
CONTAMINATION CONTROL PROCESSES AND CLEAN AREAS VERIFIED BY INSPECTION. CLEANLINESS OF VALVE VERIFIED TO PRECISION CLEAN REQUIREMENTS AT RCRS LEVEL OF ASSEMBLY.

ASSEMBLY/INSTALLATION  
INSTALLATION OPERATIONS VERIFIED BY INSPECTION.

CRITICAL PROCESSES  
TORQUE OPERATIONS VERIFIED TO H. S. REQUIREMENTS.

TESTING  
LEAK, PROOF, PRESSURE DROP, FLOW AND INTERNAL LEAKAGE TESTING PERFORMED. ATP TESTING VERIFIED TO BE WITHIN LIMITS BY INSPECTION. VIBRATION TESTING OF ORIGINAL DEVELOPMENT TEST UNIT AS A DETAIL OF RCRS PACKAGE VERIFIED BY INSPECTION.

HANDLING/PACKAGING  
HANDLING AND PART PROTECTION MAINTAINED PER H. S. REQUIREMENTS.

**(D) FAILURE HISTORY:**  
NO FAILURE HISTORY

**(E) OPERATIONAL USE:**  
- SHUT DOWN THE RCRS TO ISOLATE THE BEDS.  
- ISOLATE THE VACUUM VENT VALVE IF THE LEAK CONTINUES.  
- INSTALL NEW LIOH CANISTERS FOR CO2 REMOVAL. LIOH SUPPLY IS ADEQUATE FOR 3 DAYS.

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**- APPROVALS -**

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EDITORIALLY APPROVED : RI  
EDITORIALLY APPROVED : JSC  
TECHNICAL APPROVAL : VIA CR

*John A. Hitey* 1/18/94  
ORB0031